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Sensitivity enhancement in dual-beam mode-mismatched transient thermal lens spectroscopy by a differential approach

In dual beam, mode mismatched transient thermal lens spectroscopy (TLS), the evolution with time of the probe beam intensity after the sample´s excitation is measured at the far field and, in the conventional configuration, in the center of the beam. For samples with a negative temperature coefficient of the refractive index, a divergent thermal lens is formed after excitation, so that this intensity is a decreasing function of time. But at certain distances out of the axis of the probe beam at the detector plane, the probe beam intensity will increase with time [1]. In both cases, the total change of the intensity, measured with a photodiode as a proportional voltage difference (ΔV), determines the thermal lens signal that is proportional to the sample´s optical absorbance and thus to the concentration of the absorbing specie. Here, we use this effect to propose a differential configuration that enhances the sensitivity of the TLS method, as demonstrated by measurements performed in water solutions of a commercial dye, at different concentrations. The experimental configuration used is like that reported elsewhere [2], but the probe beam is divided so that two photodiodes can be used to measure simultaneously the increasing and decreasing signals, whose difference constitutes the differential signal. Calibration curves obtained by (a) the conventional TLS experiment and (b) using the differential configuration, showing the sensitivity enhancement and the lowering of the low detection limit (LOD) obtained with the latter.

Keywords

Spectroscopy, thermal-lens, differential-measurements, calibration-curves, sensitivity, limit-of-detection

Reference

C. Estupiñán-López, C. Tolentino Dominguez, and R. E. de Araujo, Eclipsing thermal lens spectroscopy for fluorescence quantum yield measurement, Opt. Express 21, 18592 (2013). https://doi.org/10.1364/OE.21.018592

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